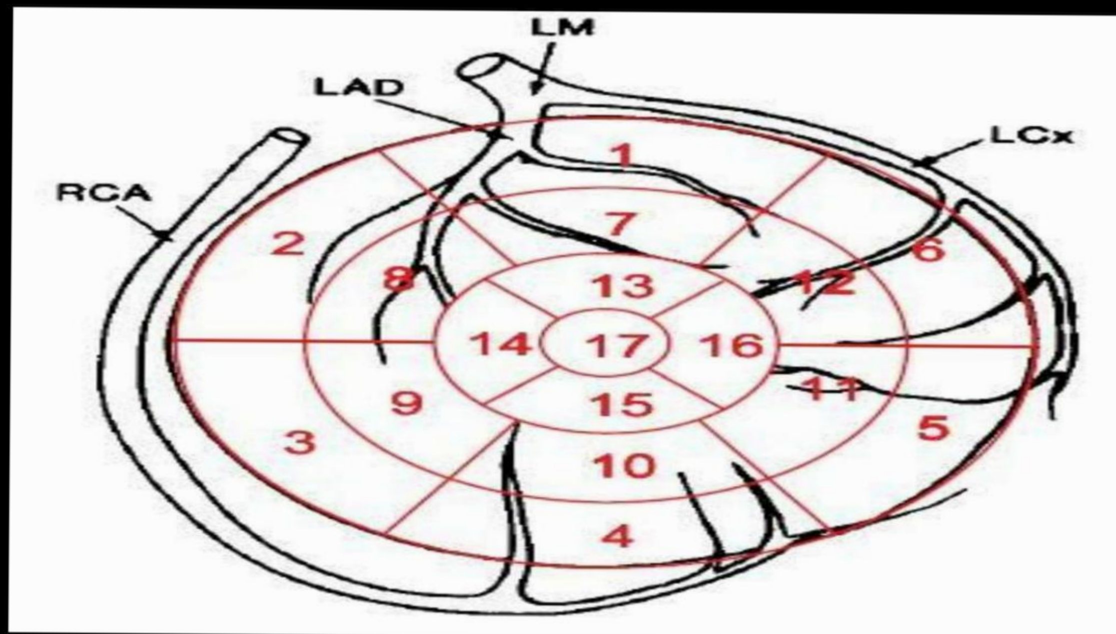
Cardiovascular imaging

Apical 4-Chamber View (A4C)
Kazi Ferdous
LV apex
Interventricular septum
Anterior leaflet
Mitral valve
Posterior leaflet
Septal leaflet
Tricuspid valve
Anterior leaflet
RV
LV
RA
LA
Interatrial septum
Descending thoracic aorta
Right lower pulmonary vein
Systole
Create PDF




LM
LAD
LCx
RCA
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17



Cardiovascular imaging

- General principles of stress tests
- Stress ECG
- Transthoracic echocardiography (TTE)
- Dobutamine stress ECHO
- Transesophageal echocardiography (TOE)
- Perfusion scintigraphy (SPECT)
- CT angiography (CTA) / coronarography (CTC)
- Cardicac MRI (CMRI)
- Invasive coronary angiography (ICA) / peripheral angiography
- Invasive hemodynamic measurement

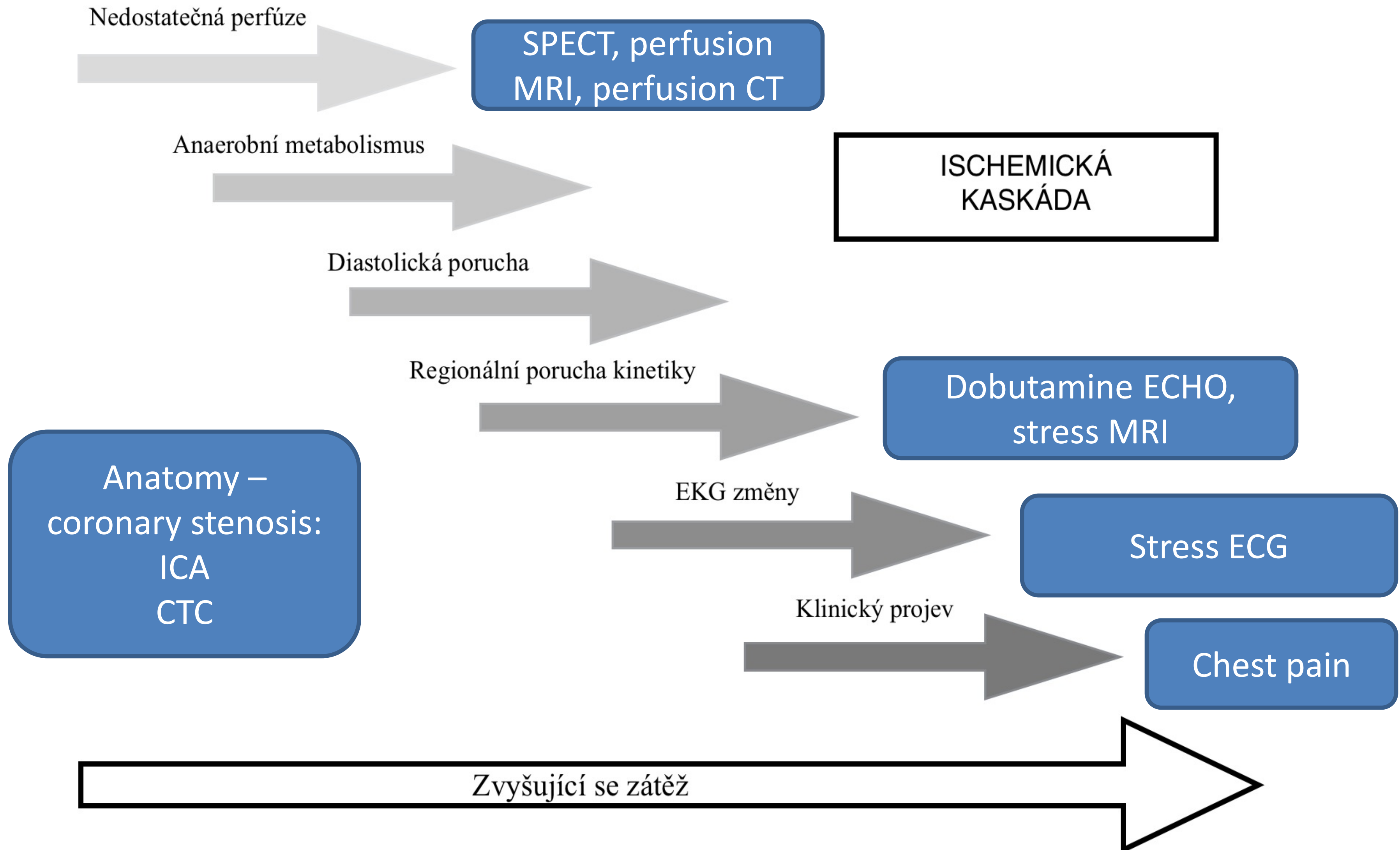


General principles of stress tests

- Ischemia testing
- Maximal workload testing (VO2max)
- Contractile reserve testing
- Viability testing
- Before the test:
  - Assess the pretest probability
  - Know sensitivity and specificity
  - Are there therapeutic consequences?



Ischemia testing

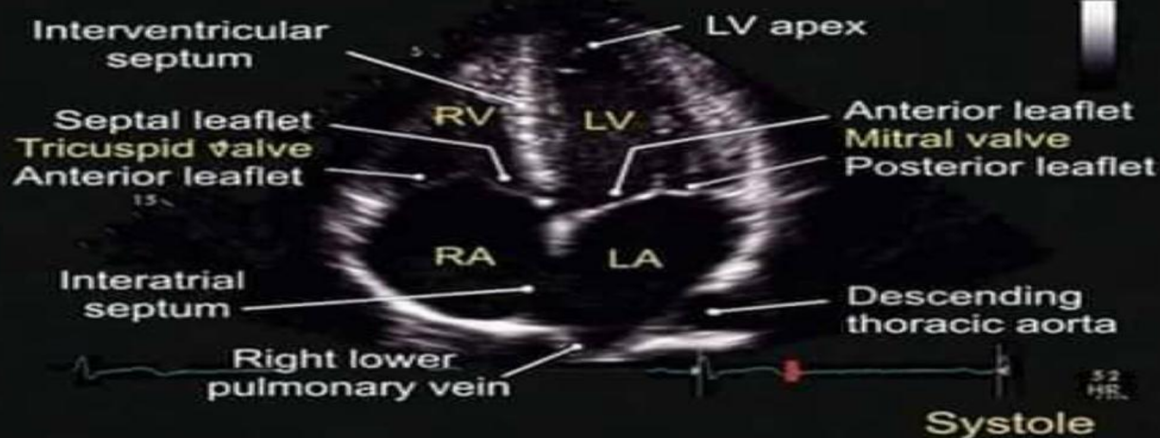


Ischemia testing

- What type of test and how to induce ischemia?
- Would stress ECG be diagnostic (LBBB, RBBB, WPW, , ST-segment changes: cardiomyopathy, LV hypertrophy, aortic stenosis, digoxin)?
- Shall I use vasodilating agent (dipyridamol, regadenoson, adenosine, nitroglycerine)?
- Shall I use inotropic agent (dobutamine)?







Apical 4-Chamber View (A4C)
Kazi Ferdous
Interventricular
septum
LV apex
Septal leaflet
Tricuspid valve
Anterior leaflet
RV
LV
Anterior leaflet
Mitral valve
Posterior leaflet
RA
LA
Interatrial
septum
Descending
thoracic aorta
Right lower
pulmonary vein
Systole

Create PDF

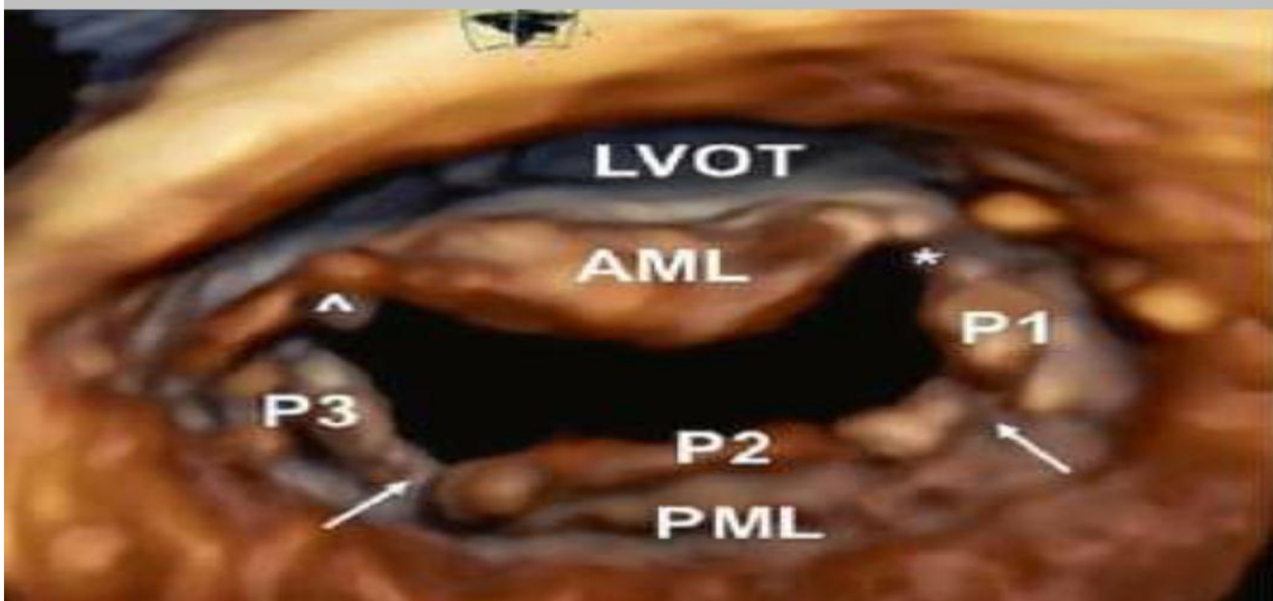







Create PDF





Create PDF

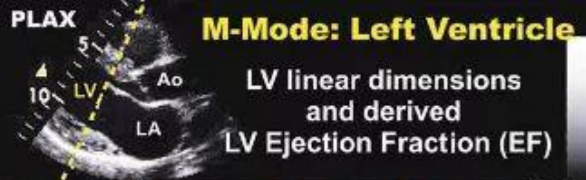




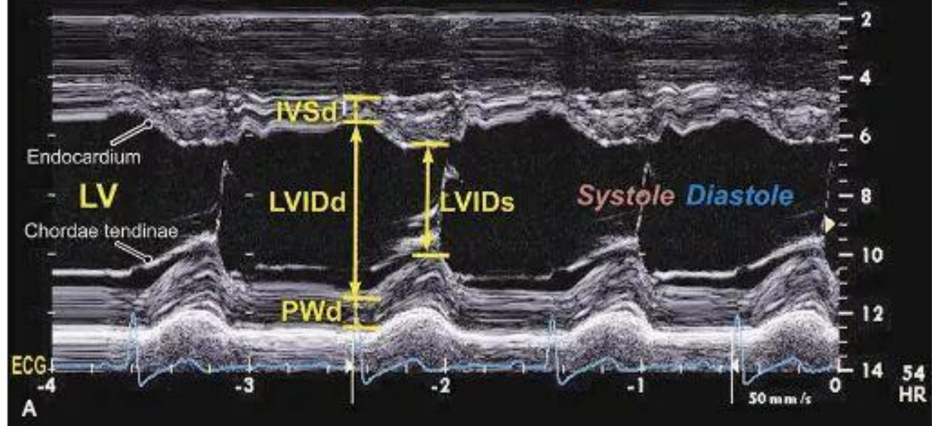

LV SEGMENTS (SHORT AXIS VIEW AT PAPILLARY MUSCLE LEVEL)
mid antero septal
8
7
mid anterior
mid septal
9
LV
12
mid lateral
10
11
mid inferior
© DVD in Medicine
26:28 / 43:06
Echocardiographic

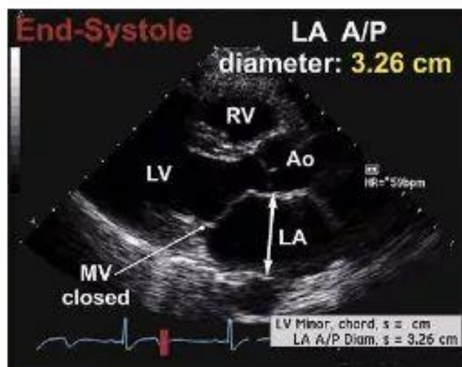
 Create PDF 

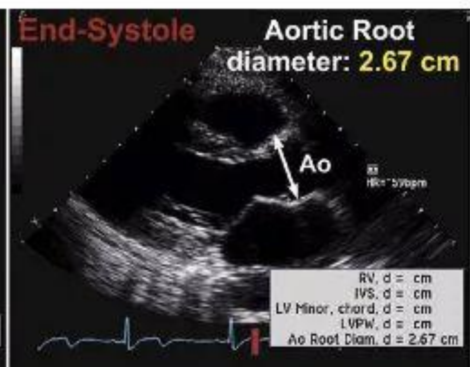
1 IVSd	0.84	cm
LVIDd	6.01	cm
LVIDs	3.72	cm
LVPWd	1.14	cm
EF(Teich)	67.31	%
%FS	38.02	%

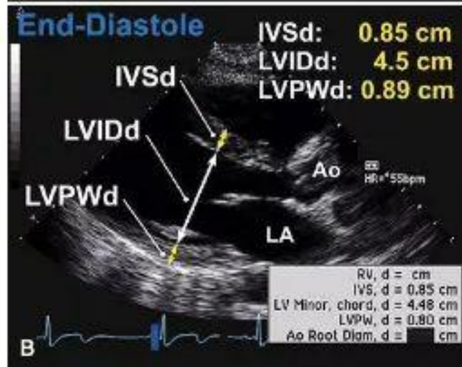


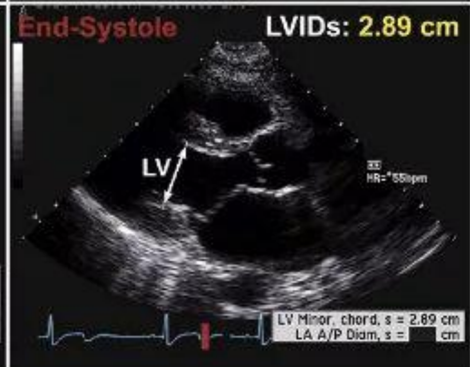
LV Ejection Fraction (Teichholz Method)











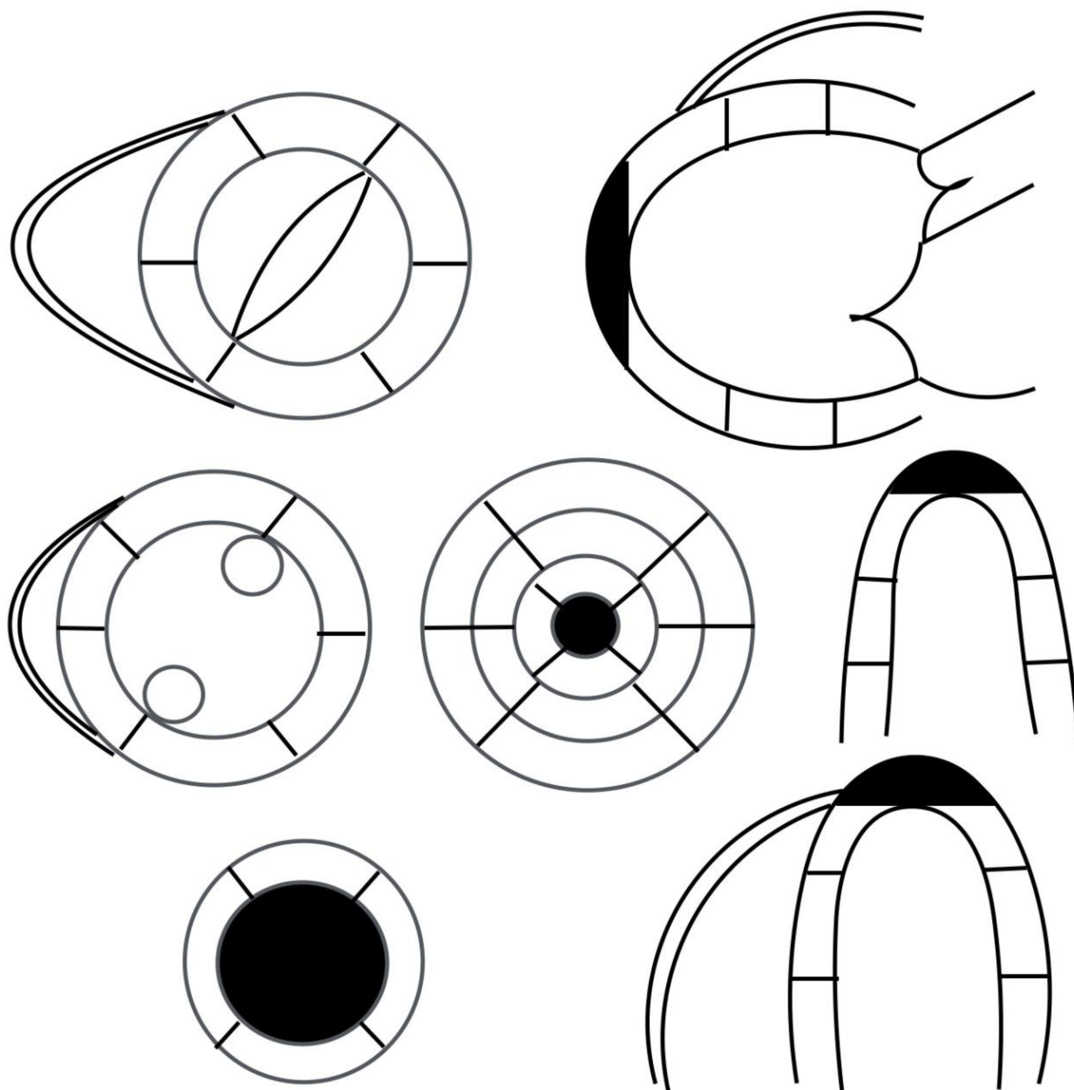
Valve Position
Posted by Medical Snippe
8,981 Views

The valve above this line is in Aortic position

Other criteria to say that the valve is in Aortic position

1. More horizontally oriented
2. In profile view
3. The perceived direction of flow of blood is towards ascending aorta

16-segment LV model



Stress ECG

- Pros: Cheap, available, fast, non-invasive
- Cons: low sensitivity, many non-diagnostic findings, does not localize ischemia
- Aim: adequate workload (W/kg, age dependent), at least submaximal heart rate 0.8x(220-age)
- Ischemia = horizonatl or descending ST-depressions at least 1mm in two leads
- Abnormal: hypertensive hyperreaction > 250/115 mmHg, drop in blood pressure, nsVT, new Afib, claudications, chest pain, dyspnea



Positive stress ECG

V5
V6

V5
V6



KARDIOLOGICKÁ KLINIKA
2. LF UK a FN MOTOL

Stress ECHO

- Dobutamine up to 40ug/kg/min
- Pros: higher sensitivity, assessment of contractile reserve
- Cons: requires good imaging window and high expertise, side effects of dobutamine



Stress ECHO

- Ischemia testing = new wall motion abnormality
- Viability testing = contraction of previously akinetic segment, increase of LVEF
- Low-flow low-gradient aortic stenosis = increase of LVEF and gradient on AV



SPECT

- i.v. Radioactive agent (Tc-MIBI, thallium) that binds to membranes in cardiocytes
- Detection of gamma radiation
- Measurement of relative LV perfusion
- Pros: Quantification and localization of ischemia, good specificity, viability???
- Cons: Intermediate sensitivity, high radiation dose



CT-coronarography

- i.v. iodine contrast agent, beta-blocker to slow HR and nitroglycerine do dilatate coronary arteries, prospective ECG gating during end-diastole
- Pros: superb sensitivity, fast, additional anatomic information (coronary anomalies, heart chambers, valves, aortic root, lungs, pulmonary artery), calcium score
- Cons: lower specificity for ischemia, poor performance in Afib, requires very good CT and expert reader
- Additional (experimental) modalities: perfusion CT, CT-FFR

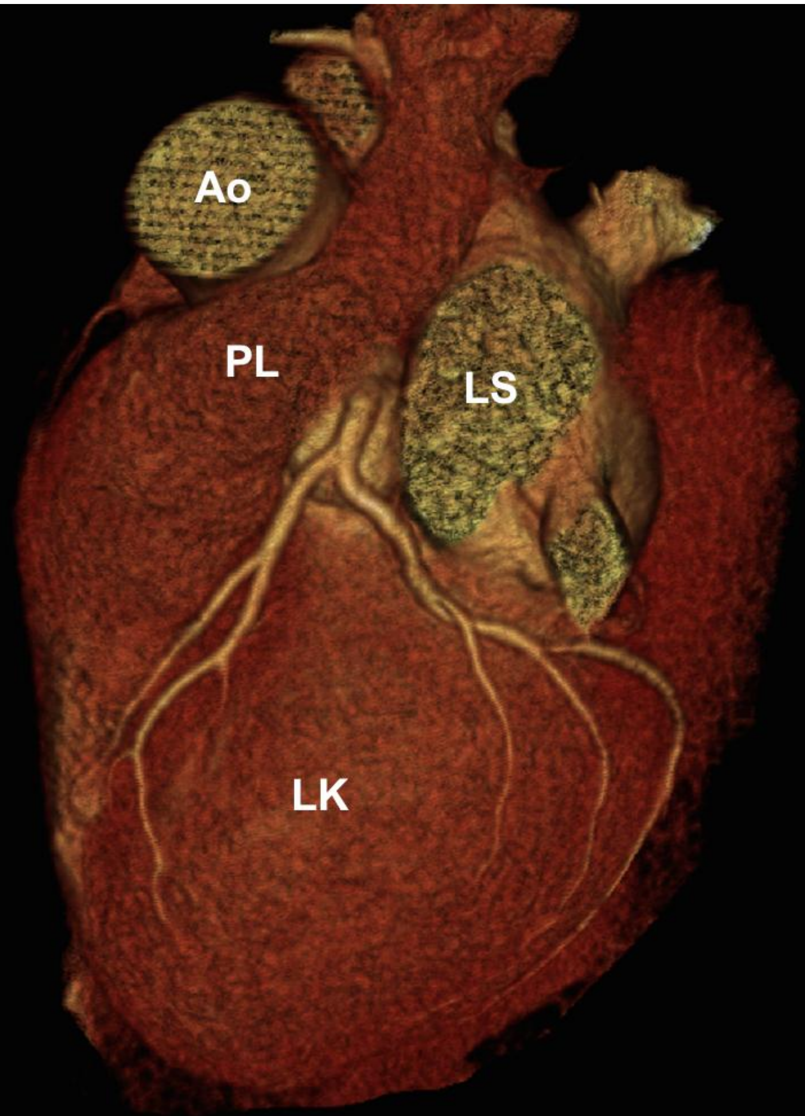


CTC



CTC





Cardiac MRI

- i.v. Gadolinium contrast agent, prospective imaging planes
- Pros: best for myocardial diseases, LV and RV volumes, masses, function and viability testing and for congenital heart diseases
- Cons: Expansive, time consuming, expet reader, perfusion and stress wall motion MRI are rarely available, does not show coronary arteries





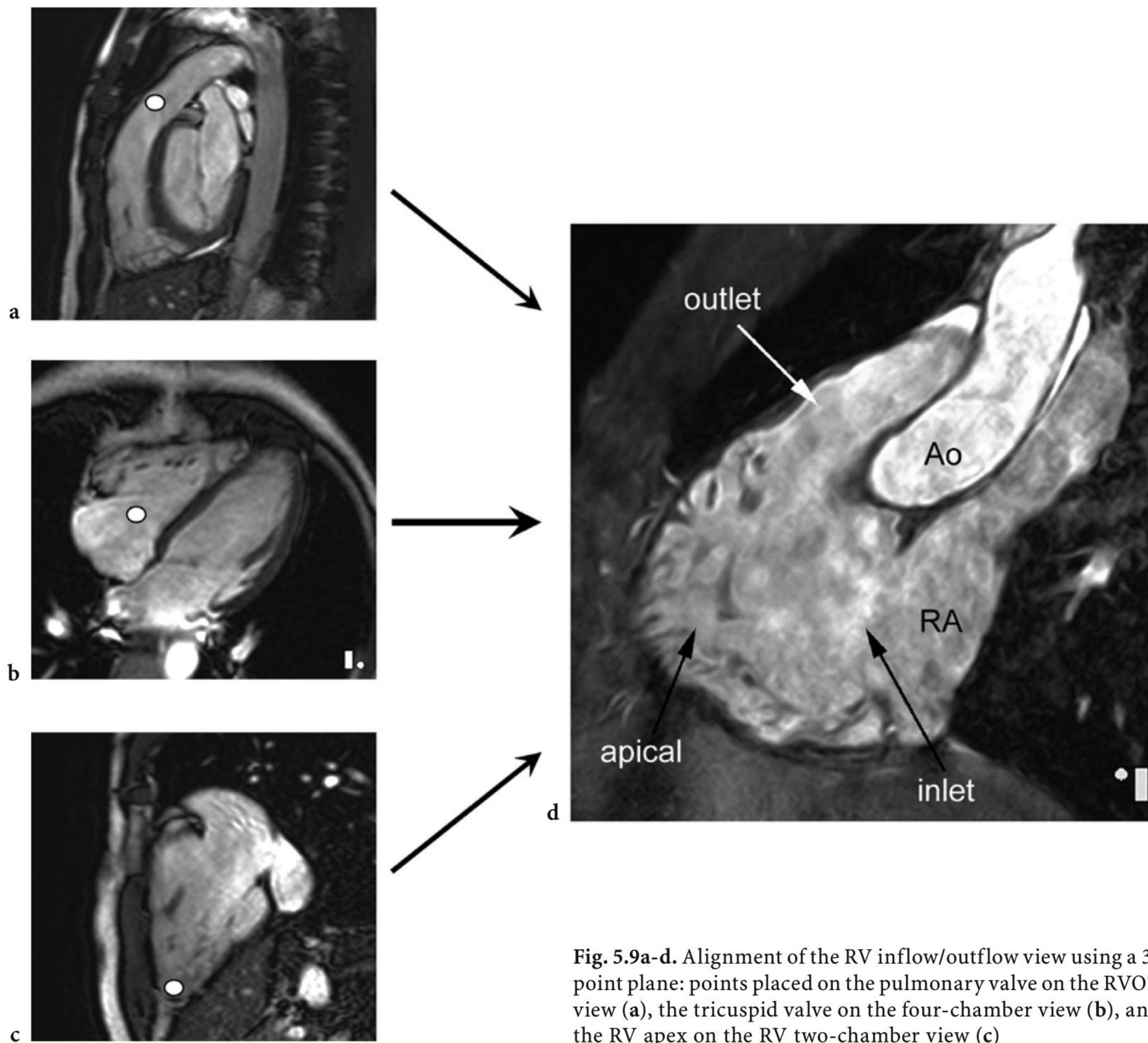


Fig. 5.9a-d. Alignment of the RV inflow/outflow view using a 3-point plane: points placed on the pulmonary valve on the RVOT view (**a**), the tricuspid valve on the four-chamber view (**b**), and the RV apex on the RV two-chamber view (**c**)







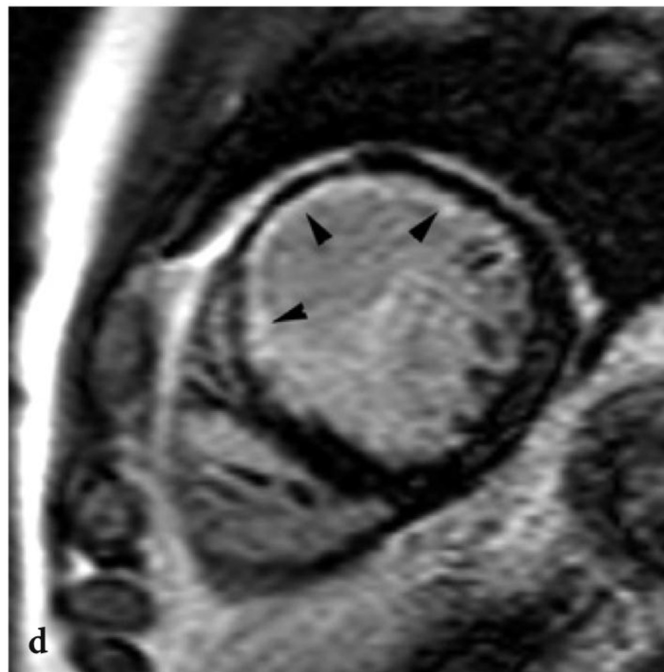
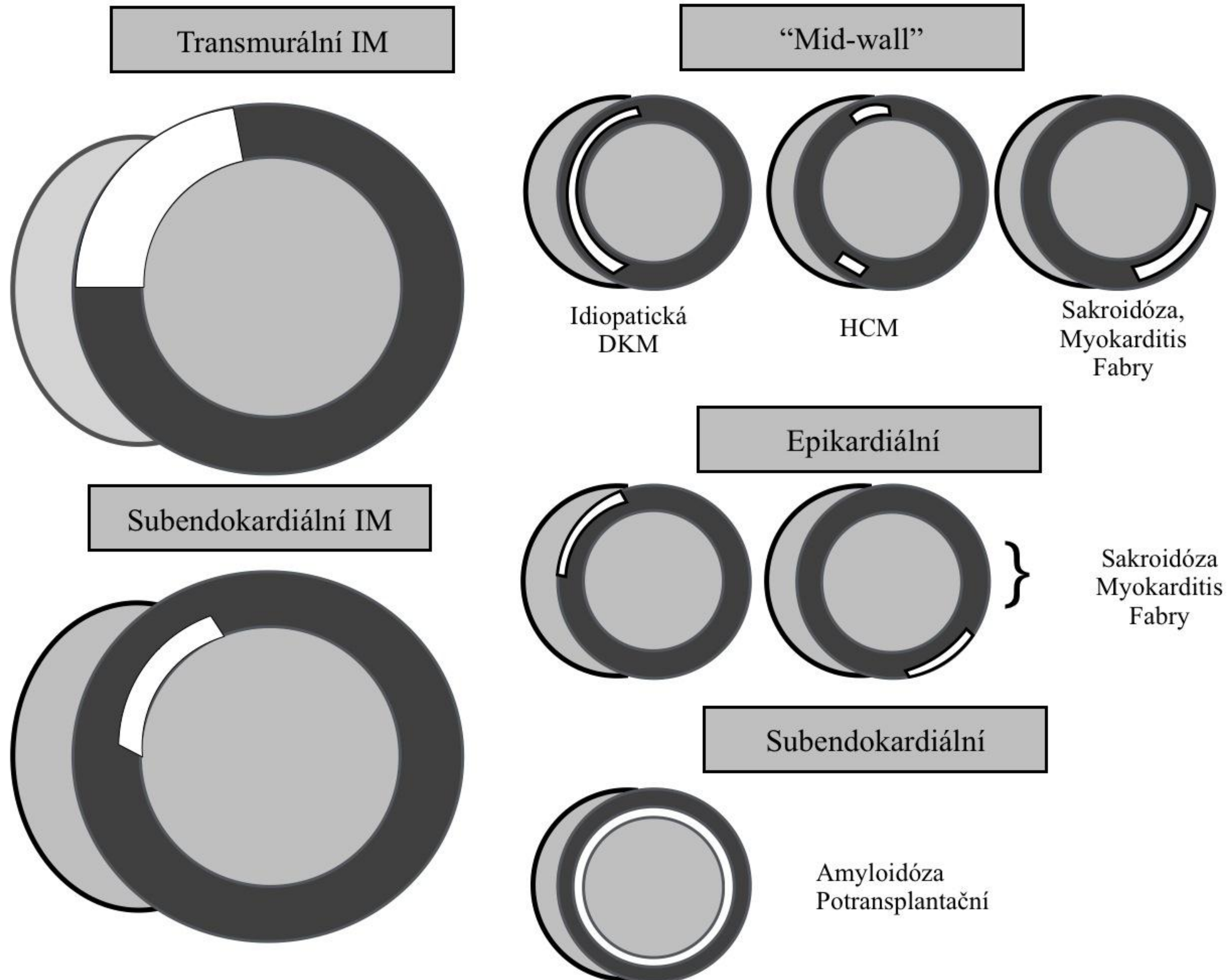


Fig. 8.16a-d Infarct shrinkage demonstrated in 54-year-old patient after LAD occlusion. *Top row*: CE-IR MRI study during the subacute phase (day 5) shows almost complete transmural enhancement in a large area located in the anteroapical wall (*arrowheads*) with several small no-reflow areas at the endocardial border. *Bottom row*: corresponding vertical long-axis (**c**) and short-axis (**d**) images taken 4 months later show significant decrease in the infarct size

CMRI – late gadolinium enhancement (LGA)

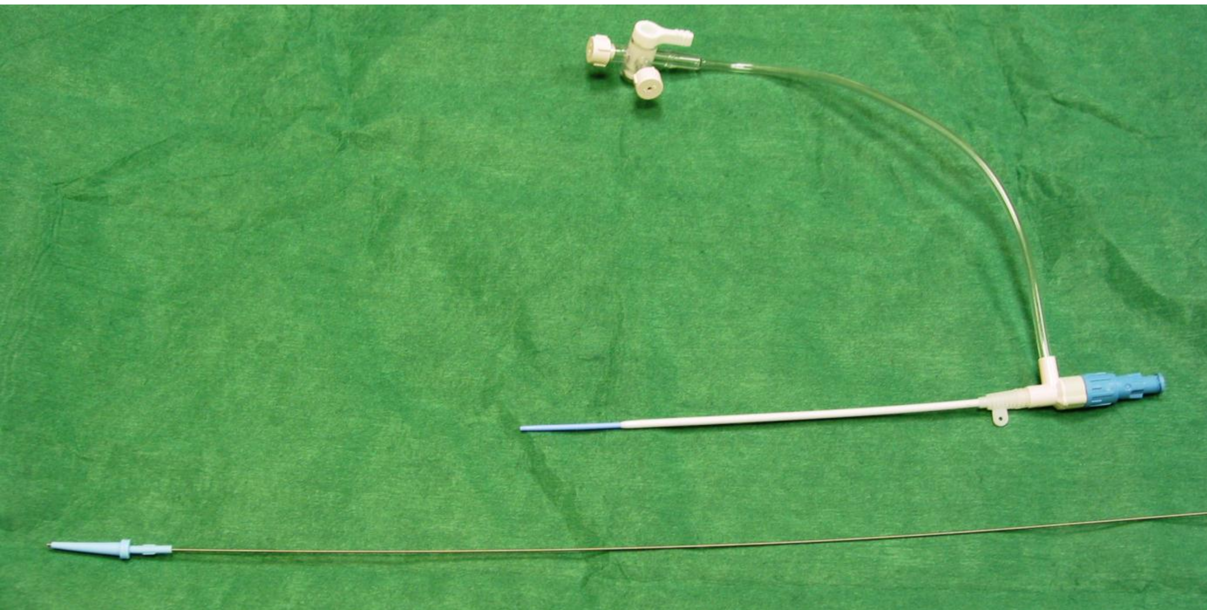


Coronary angiography

- Access site via radial, femoral or brachial artery with seldinger technique (needle, wire, sheath).
- Selective engagement of left and right coronary ostia with performed shaped catheter (4-6F = 1,33-2mm)
- In selected cases ventriculography and aortography with pigtail catheter
- Pros: Golden standard for coronary stenosis assessment, additional intravascular imaging and preassure measurement (IVUS, OCT, NIRS, FFR), direct PCI
- Cons: Expansive, bleeding and contrast nefropathy



ICA

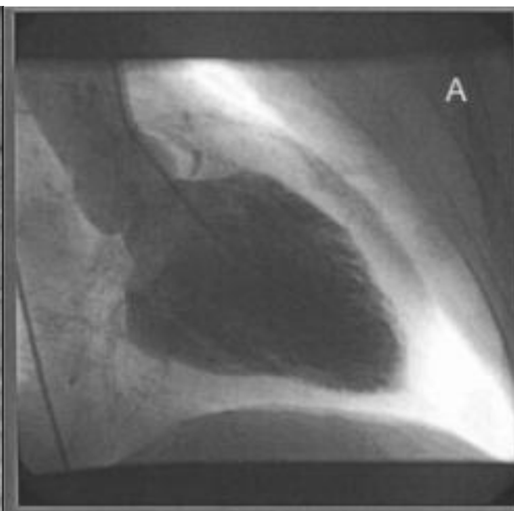


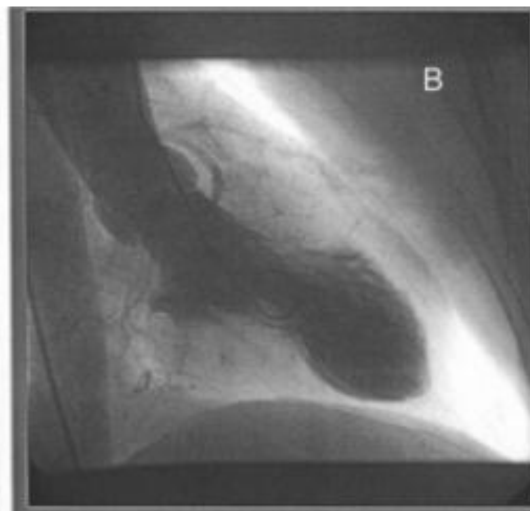
ICA



Aortography and ventriculography



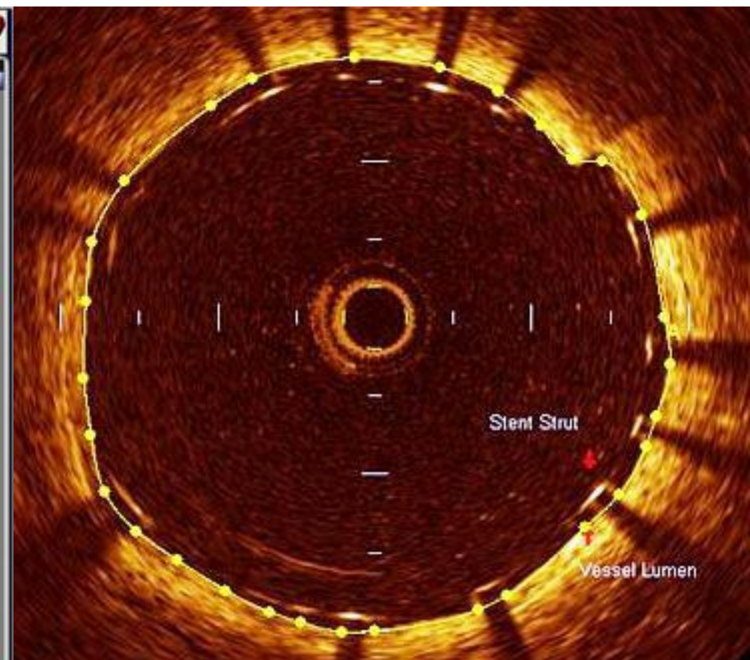






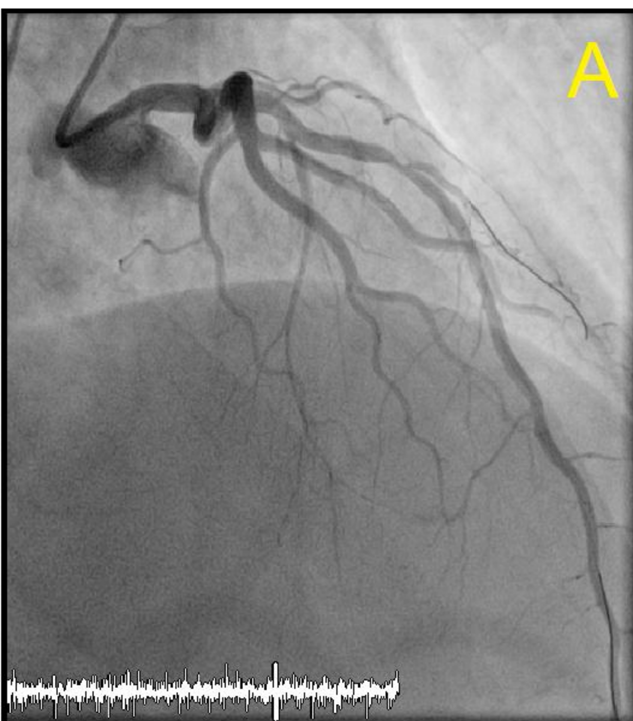
IVUS nad OCT

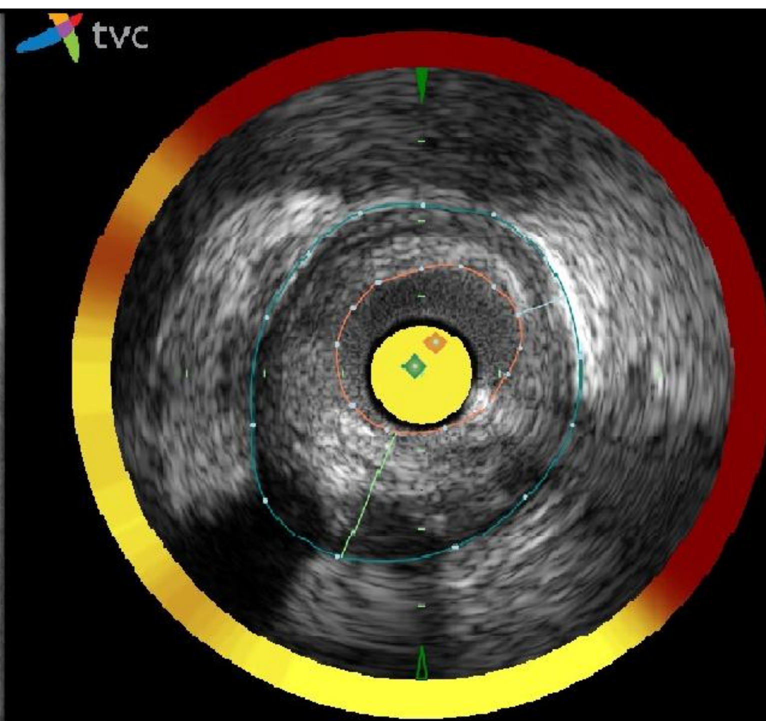
VOLCANO IVUS
, v3.2 Test Case
12345678
Case Explorer Frames: 10 Loops: 2
VL1: LAD Pre-Stent (PAUSED)
10/15/2009 14:20:14
1514
1 mm
PullBack: 80.1 mm
Area1 - Frame: 1514
Area: 19.5mm²
Min Dia: 4.9mm
Max Dia: 5.1mm
Difference
14.5mm² (74.2%)
Area2 - Frame: 1514
Area: 5.0mm²
Min Dia: 2.3mm
Max Dia: 2.9mm
TARGET ASSIST
Live
Diameter
Draw
Dots
Delete
Select Mode
Patient
Home
VH
End Case
Archive
Retrieve
Press Measure for Autoborders or Select from Measurement Toolbar

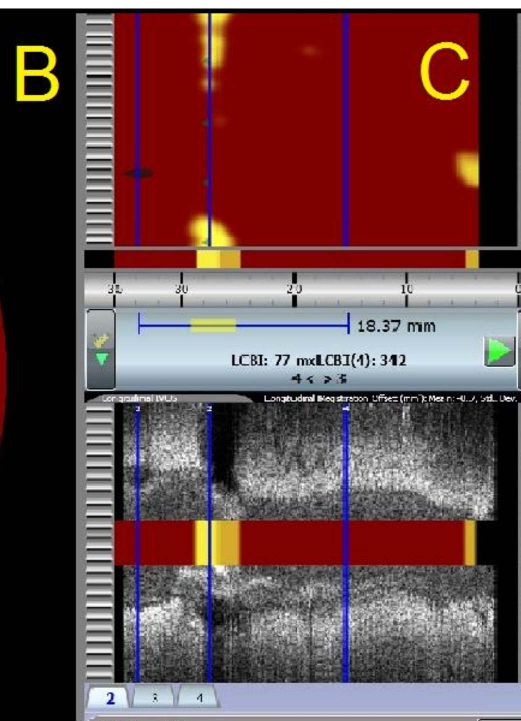




NIRS - IVUS









Fractional flow reserve (FFR)

- Introduction of FFR wire or catheter via guiding coronary catheter distal to the stenosis
- Measurement of distal preassure (Pd) and aortic preassure (Pa) after administration of intracoronary adenosine
- FFR = Pd/Pa
- Golden standard of ischemia detection (FFR<0.80)

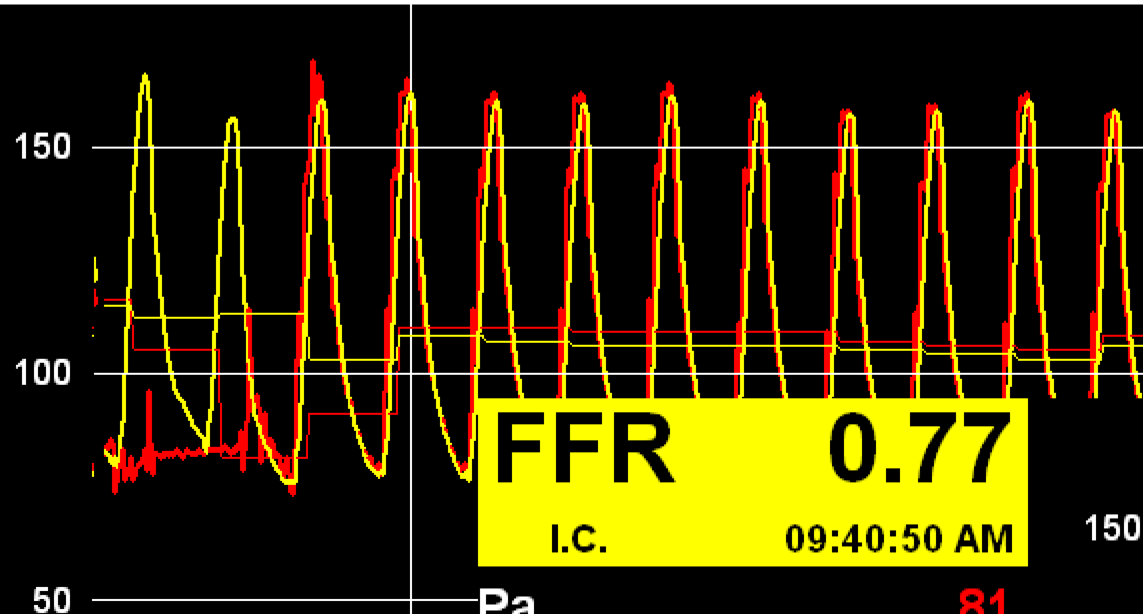


KARDIOLOGICKÁ KLINIKA
2. LF UK a FN MOTOL

FFR

FFR 0.97
I.C. 02:56:12 PM

Pa	108
Pd	105
Pd/Pa	0.97
HR	0



FFR 0.77
I.C. 09:40:50 AM

Pa	81
Pd	62
Pd/Pa	0.77
HR	73



Hemodynamic measurement

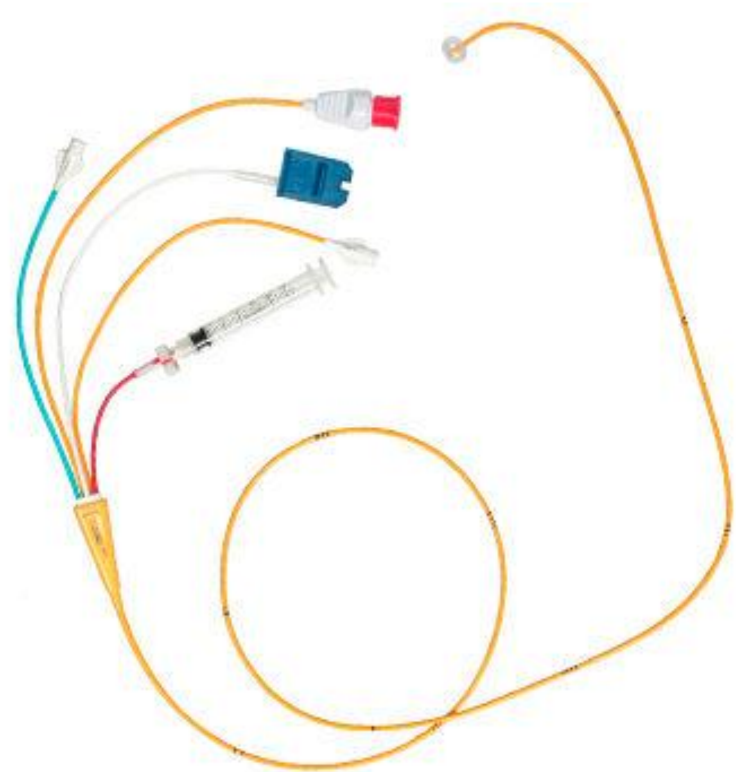
- Direct invasive measurement of pressures and saturation and assessment of cardiac output with thermodilution or O2 consuption (Fick)
- CVP – RA – RV – PA- PCWP (right side)
- Aorta – LV (left side)
- CO/CI
- Calculated: TPG, diastolic pulmonary gradient, PVR/PVRI, SVR/SVRI



Hemodynamic measurement



Vilém Ganz 1919-2009, Czech cardiologist and the co-inventor of the Swan-Ganz catheter.



Swan-Ganz catheter

Thank you for You attention!



Without imaging a doctor is blind as a mole.